

CHAPTER 3 SURFACE WATER MONITORING PROGRAMS

At the core of assessing the quality of the Commonwealth's waters are the data generated from the collection and analysis of ambient surface water samples. DEQ has a long history of water quality monitoring, beginning with the first sample collected in June 1941. Over the years, the focus of monitoring has been guided by various regulatory and assessment needs. With the development and implementation of the Water Quality Monitoring Strategy in 2000, the ambient monitoring program entered a new era of statewide multilayered network monitoring that is designed to produce representative data that supports the evaluation, restoration, and protection of the quality of the Commonwealth's waters for the purposes of fishing, swimming, boating, drinking, and the propagation and growth of a balanced, healthy community of indigenous aquatic organisms. The strategy was updated in 2004 and 2007 and has been formally approved by the United States Environmental Protection Agency (USEPA).¹

To achieve this goal and satisfy scientific, legislative and aesthetic requirements related to the quality of the Commonwealth's aquatic resources, DEQ has established a series of specific objectives to identify and define the diverse functions of the Water Quality Monitoring Program:

1. Assessment and Remediation Objectives:

(a) Status Quo Characterizations and Assessments:

- (1) Provide accurate, representative data for water quality characterization and assessment of all surface waters within the state.
- (2) Establish consistent statewide siting, parameter selection and monitoring techniques, to ensure data reliability and the comparability of data.
- (3) Assure that the frequency of sampling and the total number of observations collected are sufficient to provide adequate data for scientific, statistically based and defensible assessment procedures.
- (4) Assure that, whenever possible, flow rates are determined simultaneously with the collection of water quality data.
- (5) Monitor, according to a plan and schedule, all substances discharged into state waters that are subject to water quality standards or are otherwise necessary to determine water quality conditions.
- (6) Continually evaluate the overall success of the Commonwealth's water quality management efforts.

(b) Impaired Waters / Remediation:

- (7) Provide data to define the cause, severity and geographic extension of impaired waters:
- (8) Provide adequate data for TMDL model development and validation.
- (9) Provide adequate data, by means of follow-up monitoring, to evaluate the implementation of TMDL's and other best management practices.

(c) Variability, Trend Assessments and Forecasts:

- (10) Provide adequate data and analytical procedures for short, medium, and long-term statistical evaluation of water quality variation and trends within identifiable, geographically defined waterbodies.

2. Permit Objectives:

¹ Millennium 2000 Water Quality Monitoring Strategy, Virginia Department of Environmental Quality, October 2004.

(11) Provide data for the calculation of permit limits for the issuance, re-issuance and/or modification of effluent discharge permits.

(12) When water quality problems are suspected, provide data to detect and document water quality impairments and/or to evaluate permit adequacy, whether permitted dischargers are in compliance with permit limits or not.

3. Efficiency Objectives:

(13) Improve the efficiency of the Monitoring Program by minimizing resource requirements and the duplication of efforts while maximizing the use of integrated data collected by state and federal agencies, public utilities, private enterprises and citizens groups for statewide water quality assessments.

(14) Increase the use of biological monitoring (e.g., benthic macroinvertebrates, fish, and/or aquatic vegetation assemblages), as well as fish tissue and sediment monitoring for specific assessments of water quality.

(15) Investigate, identify and characterize additional avenues of actual or potential water quality impairment, including ground water contribution and aerial deposition.

(16) Guarantee adequate Quality Assurance/Quality Control (QA/QC) procedures to provide precise, accurate and representative water quality data for all assessment purposes.

4. Research Objectives:

(17) Provide data to validate special stream designations and/or specific water quality criteria.

(18) Evaluate new methodologies for sampling, analyzing and assessing water quality.

(19) Provide data for other research objectives.

As a result of the implementation of the new strategy, a monitoring network of multiple programs and special studies was identified and developed to include the following programs:

WATERSHED (AW) DEQ's ambient watershed network of stations represents the largest single section of the monitoring program. Detailed information on the purpose and objectives of these stations and their selection can be found in Section III.B. of the Monitoring Strategy.

ESTUARINE PROBABILISTIC MONITORING (C2) The estuarine probabilistic monitoring program covers the tidal estuarine waters of the Chesapeake Bay, coastal Delmarva and the Back Bay / North Landing River drainages. It is designed to characterize the Commonwealth's estuarine waters. This program is also integrated into National Coastal Assessment Surveys on a rotating basis once every five years.

CHESAPEAKE BAY (CB) Chesapeake Bay Program identified in section III.E.1 of the strategy. The design of this program is through the Federal-Interstate Chesapeake Bay Program and encompasses a multi-state water quality characterization effort, <http://www.deq.virginia.gov/Programs/Water/ChesapeakeBay.aspx>.

CITIZEN MONITORING (CM) These stations are monitored due to specific requests from the public, usually as a result of local concerns. Notification occurs in the fourth quarter of the calendar year with sampling scheduled to begin in the next monitoring year, <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx>.

FACILITY INSPECTION (FI) Facility inspections are not specifically identified in the water quality monitoring strategy but are integral to determining compliance with discharge limits. Specific sample locations are not included in the monitoring plan but only estimated numbers of samples for the purpose of calculating annual budgets.

FRESHWATER PROBABILISTIC (FP) The freshwater probabilistic monitoring program covers the non-

tidal free-flowing waters of the state. The program is designed to answer the question of what is the overall water quality of the Commonwealth for free-flowing streams: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/ProbabilisticMonitoring.aspx>.

FISH TISSUE (FT) Fish tissue and sediment monitoring program² conducted by central office staff, <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/FishTissueMonitoring.aspx>.

MERCURY (HG) Mercury Special Study Program paid for by the responsible parties.

INCIDENT RESPONSE (IR) Incident response samples are the same as PC but are non-petroleum in origin.

POLLUTION COMPLAINTS (PC) Pollution complaints are special samples collected generally as a result of a petroleum spill.

REGIONAL BIOLOGICAL (RB) Biological monitoring program which focuses on the analysis of the benthic macroinvertebrate community as a tool to detect water quality conditions. The methodology follows the USEPA Rapid Bioassessment Protocol II. For additional information visit the biological program website at <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/BiologicalMonitoring.aspx>.

RESERVOIR MONITORING (RL) Reservoir monitoring which is described in the Lake Monitoring Guidance³ available at <http://www.deq.virginia.gov/Portals/0/DEQ/Water/Guidance/092005.pdf>.

SPECIAL STUDIES (SS) Special studies are identified by individual project plans and are generally specialized intensive targeted monitoring efforts designed to answer specific hypothesis related to water quality conditions.

TMDL (TM) TMDL monitoring stations are those stations associated with the development of a TMDL and subsequent implementation plan for segments listed on the 303(d) list, <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL.aspx>.

TREND (TR) Trend stations are those long term stations sited for permanent monitoring for the purpose of detecting water quality trends for a wide variety of environmentally important water quality parameters.

OBSERVED EFFECTS (OE) Those stations with insufficient data for assessing and usually are those stations with small data sets during an assessment cycle that indicate a potential problem. These stations are considered carryover stations and will be sampled until sufficient data is available to determine the water quality conditions.

Data Summary

Between January 2007 and December 2012 DEQ staff collected multiple samples at 4,328 stations. From these stations, the number of independent observations for the common field measurements was 173,757 for temperature, 149,247 for pH, and 168,635 for dissolved oxygen. These samples were analyzed for a variety of chemical constituents including nutrients, bacteria, metals, pesticides, herbicides and toxic organic compounds; over 600 different parameters were sampled.

² Virginia Department Of Environmental Quality, Water Quality Standards, Office Of Water Quality Programs 2001 Fish Tissue And Sediment Monitoring Plan, May 9th, 2001.

³ Lake Monitoring Guidance, Virginia Department of Environmental Quality, December 1999. Revised in 2002

The number of stations representing a particular type of stream segment, the types of samples collected, the parameters analyzed, and the sampling frequency all vary depending on site conditions and program emphasis. A detailed report of sample locations, matrices, parameters, and frequency is available in the Annual Monitoring Plans at <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring.aspx>.

Each basin summary, found in Chapter 4.3 of this report, lists the ambient water quality monitoring (AWQM) and biological (benthic) monitoring summary data within the basin. Summaries of the sampling data collected at each station during the reporting period are provided as an Appendix supplement to this report and can be found on the DEQ water webpage <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs.aspx>.

Contact: For further information on the Ambient Monitoring Program contact:

Roger E. Stewart
629 East Main Street
Richmond, Virginia 23219
(804) 698-4449
roger.stewart@deq.virginia.gov

This chapter describes the water monitoring programs that provide data used in the 303(d)/305(b) assessment process.

CHAPTER 3.1 FRESHWATER BIOLOGICAL MONITORING PROGRAM

Virginia's freshwater biological monitoring program began in the 1970s to fulfill requirements of the Federal 106 Grant agreement. DEQ uses benthic macroinvertebrate communities to assess the ecological health of Wadeable freshwater streams and rivers. Benthic macroinvertebrates are animals without backbones that live in or on sediment or other substrates and can be seen by the unaided eye. Benthics include crustaceans, mollusks, and immature forms of aquatic insects such as caddisfly, stonefly or mayfly nymphs.

Biological monitoring, using benthic macroinvertebrates, is an invaluable tool for evaluating the temporally integrated, overall effects of the water and sediment quality in streams and rivers. Benthic macroinvertebrate communities integrate water quality and the effects of different pollution stressors through time, providing a holistic measure of their aggregate impact. Because of their sedentary nature, macroinvertebrates are good indicators of localized conditions. Most species have a complex life cycle of approximately one year or more, and thus integrate the effects of fluctuations in water quality over time which conventional water quality surveys may miss. In essence, benthic macroinvertebrates are considered to be virtual "living recorders" of water quality conditions over time. The structure and functioning of macroinvertebrate communities are extremely sensitive. These communities may exhibit responses to water quality pollutants for which specific criteria or standards have not been defined, chemical analyses are not normally performed, or tolerance is below chemical detection limits.

DEQ's biological monitoring program examines over 150 stations annually. Reasons for bioassessments can include targeted monitoring, probabilistic monitoring, tracking local pollution events, follow-up on waters of concern identified through volunteer citizen monitoring and TMDL monitoring. Data from the biological monitoring program are used for periodic review and assessment of state waters as required by Section 305(b) of the Clean Water Act. Biological monitoring is one tool used for assessing the aquatic life designated use of state waters established in 9 VAC 25-260-10 A. that states in part, "All state waters, including wetlands, are designated for the following uses: ...the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them..."

DEQ uses two bioassessment indices to assess the biotic integrity in non-tidal freshwater streams and rivers in Virginia. In the Coastal Plain, which is characterized by low gradient streams east of the fall line, the Virginia Coastal Plain Macroinvertebrate Index (VCPMI) methodology is used. This multimetric index was developed in 1997 by the Mid-Atlantic Coastal Streams (MACS) workgroup. The VCPMI is a multimetric bioassessment index which was calibrated for low gradient Coastal Plain streams which exhibit different benthic macroinvertebrate communities from non-coastal stream communities.

For non-coastal streams, assessment of the benthic macroinvertebrate community is based on the Virginia Stream Condition Index (VSCI). The VSCI was developed for Virginia freshwater non-coastal streams by USEPA's contractor Tetra Tech, Inc. Using historical data collected in Virginia at reference and stressed streams from 1994-1998, Tetra Tech compared the historical data against additional data collected from 1999-2002. The VSCI is based upon recent advances in bioassessment methods contained in "*Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers, Second Edition*" (Barbour et al. 1999). The VSCI, a multimetric calculation of benthic integrity converted into a single numerical score, resulted in a single reference condition for the entire non-coastal portion of the Commonwealth against which all future benthic samples will be compared. The development of this index is considered a significant step in the advancement of the biomonitoring program to address a wide range of monitoring and assessment needs. Based on recommendations from public comment and the Academic Advisory Committee, the VSCI was validated using a spatially diverse (ecoregionally and stream size) data set free of pseudoreplication. These probabilistic data sets have allowed DEQ to narrow data gaps and test the VSCI against many classification variables and confirm with certainty, the VSCI is a good assessment tool for Virginia streams.

Contact: For further information on the Freshwater Benthic Macroinvertebrate Monitoring Program contact:

Richard Browder
629 East Main Street
Richmond, Virginia 23219
(804) 698-4134
richard.browder@deq.virginia.gov

CHAPTER 3.2 ESTUARINE/COASTAL PROBABILISTIC MONITORING PROGRAM

Virginia's estuarine probabilistic monitoring module was initiated in the summer of 2000 with a five-year grant (CR-828544-01 – period 2000-2004) from EPA's "National Coastal Assessment (NCA) Program", formerly known as the "Coastal 2000 Initiative". This original, five-year effort was defined under the terms of a proposal titled "Monitoring the US Atlantic Coast: Assessing Virginia's Estuaries and Tidal Tributaries to the Chesapeake Bay and the Atlantic Ocean", submitted to the US-EPA in the spring of 2000. Specific field methodologies and Quality Assurance requirements of the Coastal 2000 / National Coastal Assessment Program are described in the EPA documents "[National Coastal Assessment Field Operations Manual](#)" (EPA 620/R-01/003) and "[National Coastal Assessment Quality Assurance Project Plan 2001-2004](#)" (EPA/620/R-01/002).

Purpose

The original goals of the National Coastal Assessment (Coastal 2000) Program were to:

- Assess the ecological condition of estuarine resources,
- Determine reference conditions for ecological responses/stressors, and
- Build infrastructure in EPA Regions and participating states.

Additional, more specific federal objectives were to:

- Assess the health or condition of the estuarine waters of the United States and track changes in that condition through time,
- Assess the health or condition of the estuarine waters of the various coastal states and track changes in that condition through time,
- Utilize the approach to identify reference conditions for estuarine waters in the United States, and
- Utilize existing state monitoring programs as appropriate

The geographic extent of the Estuarine/Coastal ProbMon Program is restricted to the eastern-most regions of the state. It is coordinated through the DEQ Central Office in Richmond and is carried out primarily by the Piedmont (PRO - Glen Allen) and Tidewater (TRO - Virginia Beach) Regional Offices. A few of the estuarine probabilistic sites (usually 1 or 2 sites annually) fall within the geographic jurisdiction of the Northern Regional Office (NRO) in Woodbridge.

At the state level, DEQ defined its agency goals and objectives relative to its comprehensive statewide Water Quality Monitoring (WQM) Program. Each participating DEQ region needs to complete its assigned probabilistic stations in order for DEQ to reach defensible conclusions about overall estuarine water quality from a statewide perspective.

Monitoring Design

The sampling strata for tidal tributaries have been geographically defined, by estuary size and drainage location, and a set of 50 randomly selected sampling sites are selected each year. In the past these were provided annually by the EPA/ORD Gulf Ecology Division (GED) Laboratory in Gulf Breeze, Florida (2000-2004), or the Atlantic Ecology Division (AED) Laboratory in Narragansett, Rhode Island (2005-2007) upon request. Since 2007 DEQ has performed its own site selection for the state sampling design using software provided by EPA/ORD/AED.

The two principal sampling strata in the state design consist of (1) small tidal tributaries to the Chesapeake Bay and its major tributaries and (2) tidal tributaries and embayments of the Atlantic coast and Back Bay/North Landing River (which discharge into Pamlico/Albemarle Sounds, North Carolina). The major tidal tributaries to the Chesapeake Bay (the Potomac, Rappahannock, York and James Rivers), as well as the Bay mainstem, are effectively characterized by the probabilistic monitoring of Virginia's Chesapeake Bay Program. Periodically (2000, 2005-06, and 2010), these larger waters were also included in the national

survey sampling design for the purpose of integration into the standardized National Coastal Assessment (NCA) Program.

In the first year of sampling, 35 sites were selected in Virginia's portion of the Chesapeake Bay mainstem and the tidal portions of its major tributaries (Rappahannock River, York River, James River, & Elizabeth River - the tidal portions of the Potomac River mainstem are entirely in the state of Maryland). To better characterize smaller estuarine subdivisions, DEQ has in subsequent years (2001-2004) emphasized, and will continue to emphasize, minor tidal tributaries to the Chesapeake Bay, the Atlantic Ocean, and to Pamlico/Albemarle Sound by sampling at 50 sites annually. Virginia's participation in the interstate Chesapeake Bay Program already provides adequate probabilistic monitoring for the characterizations of the Chesapeake Bay mainstem and its major tidal tributaries (e.g., lower Potomac, James, York, and Rappahannock Rivers). The "weighting" of the current sampling design guarantees that each year approximately 70% of the sites (~35 stations) are selected in the Chesapeake Bay drainage and approximately 30% (~15 sites) are selected in coastal drainages. This assures that approximately 90 sites will be available to characterize the coastal estuary resource class by the end of each six-year period.

Core and Supplemental Water Quality Indicators

From 2001 through 2006, with the resources provided by EPA NCA/Coastal 2000 Grants, estuarine probabilistic stations were sampled for the complete suite of parameters described in the National Coastal Assessment QAPP cited above, as well as additional parameters utilized by the Chesapeake Bay Program. The total suite of water column parameters includes profiles of temperature, pH, DO, salinity and Photosynthetically Active Radiation (PAR), as well as samples for chlorophyll, nutrients and suspended solids measurements at near-surface, mid-depth and near-bottom. In addition, homogenized sediment samples are collected for local (DCLS) analyses of particle size and total organic carbon (TOC), as well as for metals and organic contaminant analyses and toxicity testing at EPA-contracted laboratories. A separate, 0.04 m² sediment sample is collected and sieved in the field for later identification of macroinvertebrate benthic infauna species to complete the "Sediment Quality Triad" (SQT) for "weight-of-evidence" ecological evaluations and assessments. In the past, EPA Grant funds also provided for the contracting of the Fisheries Science Laboratory at the Virginia Institute of Marine Science (VIMS) for fish trawls. These trawls were used to collect fish community-structure data, epibenthic organisms, incidental fish for pathological examinations, and targeted fish species for the analyses of metals and organic contaminants in whole fish tissues. Due to resource limitations, fish sampling is only included when additional funds are available for national surveys. Beginning in the summer of 2003, DEQ started supplementing the NCA core indicators with additional sampling for bacteria (fecal coliform, *E. coli*, and enterococci) and when resources permitted for dissolved and total trace metals.

Sample handling and shipping varies with the type of sample and its final destination for analysis. All samples are collected from boats anchored at the monitoring sites and are appropriately labeled and stored on wet ice at 4° C during transport to the responsible DEQ Regional Office. Samples to be analyzed at the Virginia State laboratory (DCLS) are maintained on ice and shipped daily to Richmond by overnight courier service. Such samples are received and processed within 24 hours of collection. Analyses are completed within the holding time specified in the pertinent QAPPs and EPA analytical method descriptions, after which the resultant data is entered into the DCLS LIMS system. Analytical results are subsequently transmitted to and permanently stored in the DEQ CEDS 2000 database on a daily basis. Turnaround time from sample arrival at DCLS to receipt of analytical data varies from 48 hours to 21 days, depending upon sample type.

Sediment samples that are analyzed chemically and toxicologically by other contracted laboratories are held under refrigeration at DEQ Regional Offices and are shipped to Richmond by courier on a weekly basis. Sediment toxicity samples are united and shipped weekly via overnight air to the contracted laboratory. Sediment chemistry samples are frozen and accumulated prior to shipping to the contracted laboratory. Typically, the sediment chemistry samples are delivered in two batches, one at the midpoint and one at the end of the sampling season. Benthic infauna samples are preserved in (10%) buffered formalin as soon as they are collected and are maintained at DEQ Regional Offices until the end of the field season (late September). They are then united at the DEQ Central Office and shipped to the Benthic Ecology Laboratory at Old Dominion University (ODU). Sediment chemistry and toxicity results are generally received by the end

of the calendar year. The separation, identification and enumeration of benthic taxa require more time, and results from benthic analyses performed at ODU are normally available the following spring.

When included in the program, data related to fish community structure, epibenthic invertebrates, and habitat collected by VIMS trawl sampling are immediately entered into their onboard SAS database during the process of collection. Target fish species selected for chemical tissue analyses are individually labeled and wrapped and maintained on ice during transport to the laboratory. Once there, they are frozen and maintained until the end of the field season (October). They are shipped overnight, on dry ice, to EPA/GED for storage and later transshipment. Fish pathology specimens are maintained in Dietrich's solution until the end of the field season and are subsequently shipped to EPA/GED. Fish community, epibenthic macroinvertebrate and habitat data are united into a final report which VIMS sends to DEQ soon after the end of the field season in October or early November. Turnaround time for fish tissue chemical data and fish pathology data from EPA-contracted laboratories is currently at least two years.

Frequency/Duration

As is typical of probabilistic survey programs, monitoring sites are sampled only once and new sites are randomly selected each year. Under the conditions defined by the NCA QAPP, sampling occurs during the summer months from 1 July through 30 September. This period also coincides with the sampling "window" defined for the use of the Chesapeake Bay Program's ["Benthic Index of Biological Integrity"](#) (B-IBI), which is utilized to evaluate the ecological health of the benthic community.

DEQ's Estuarine Probabilistic Monitoring Program was proposed and developed as a major component of the agency's Ambient Water Quality Monitoring Program and is fully implemented at this time. The resources formerly provided by the initial EPA Coastal 2000 Grant facilitated the implementation of the program in 2000 and terminated at the end of September 2004. A transitional National Coastal Assessment Grant provided funding at a reduced level during the 2005-2006 interim. Beginning in 2007, DEQ has continued the Estuarine ProbMon Program with a slightly reduced suite of parameters using supplemental probabilistic monitoring funds from federal §106 grants, complimented by Chesapeake Bay and general fund resources.

Quality Assurance Measures

DEQ's field and laboratory activities adhere to QA/QC protocols specified in the [National Coastal Assessment Field Operations Manual](#) (EPA 620/R-01/003) and the [National Coastal Assessment Quality Assurance Project Plan 2001-2004](#) (EPA/620/R-01/002), except where specific variations have been authorized by the Regional NCA QA Officer. Authorized departures include the use of submerged pumps and hoses for the collection of subsurface water samples and vacuum field-filtration of nutrient and chlorophyll samples. Both of these procedures are specifically described in the corresponding sections of the contemporary QAPP and SOPs for Virginia's Chesapeake Bay Monitoring Program.

DEQ requires that a minimum of 10% QA samples (field duplicates, field blanks, etc.) be collected at estuarine ProbMon field sites for all locally analyzed parameters. At present, one or two QA sites from among the 50 sites sampled are randomly selected annually for each of the three DEQ Regional Offices.

Data Management

Both samples and the resultant data collected within the Estuarine Probabilistic Monitoring Program follow diverse pathways. Standard procedures for the preservation, transportation and delivery of samples to the Virginia Division of Consolidated Laboratory Services (DCLS) and of sample shipment to other contracted laboratories were described above.

The data flow and data management for water and sediment samples analyzed by DCLS follow pathways and turnaround times as described for the WQM Program in general. Analytical results are quality assured by DCLS and stored in their LIMS database. Results that are complete and certified there are subsequently shipped electronically to the DEQ FTP site for upload into the CEDS 2000 database on a daily basis.

Currently, all data from locally (DCLS) analyzed samples reside in DEQ's CEDS database. All analytical results receive a QA review at DCLS, prior to shipment to the DEQ database, and another QA review by programmed algorithms (data range screenings, etc.) within the CEDS database. Data that are 'flagged' by the automated screening procedures undergo an additional evaluation by DEQ's QA Officer. Whatever questions arise concerning the location, date and time of samples arriving at DCLS, or about the accuracy of DCLS data transmitted to the CEDS database are resolved immediately via e-mail and voice communication between laboratory personnel and monitoring personnel at the DEQ Central or appropriate Regional Office.

Looking to the Future

The National Coastal Assessment Program (Coastal 2000 Initiative) was instituted by EPA's Office of Research and Development (ORD) as an experimental program in 2000. The original five-year program was so successful and so well accepted by the participating coastal states that it was transferred to EPA's Office of Water (OW) as a permanent component of its national water quality monitoring strategy. An interim two-year grant supported the program (at a reduced level) during the 2005-2006 transition. Since then, the program has received partial support via the normal § 106 federal grant process.

Beginning in the summer of 2005, portions of the national design were coordinated with and integrated into the Chesapeake Bay Program's (CBP) probabilistic benthic monitoring program. Probabilistically-collected sediment-related parameters (sediment chemistry, sediment toxicity and benthic community structure – the 'Sediment Quality Triad' or SQT) from the minor tidal tributaries will supplement CBP efforts in the major tidal tributaries and mainstem of Chesapeake Bay. Use of the SQT facilitates the characterization and aquatic life use assessment of these minor tidal tributaries, where sample sizes are generally insufficient to apply the formal statistical assessment method utilized for the Benthic Index of Biological Integrity (B-IBI) in larger Chesapeake Bay assessment units (segments).

EPA carries out national probabilistic surveys on various aquatic resource classes on a five-year rotational basis. The last National Coastal Survey was performed in 2010. The most up-to-date NCA data can be found here: <http://www.epa.gov/emap/nca/html/data/index.html>.

Contact: For further information on the Estuarine Probabilistic Monitoring Program contact:

Donald H. Smith, Ph.D.
Virginia Department of Environmental Quality
629 East Main Street
Richmond, Virginia 23219
(804) 698-4429
donald.smith@deq.virginia.gov

CHAPTER 3.3 ESTUARINE BENTHIC MACROINVERTEBRATE MONITORING PROGRAM

Benthic organisms are important secondary producers, providing key linkages between primary producers (phytoplankton) and higher trophic levels (crabs, bottom feeding fish and water birds). Benthic invertebrates are among the most important components of estuarine ecosystems and may represent the largest standing stock of organic carbon in the Chesapeake Bay. Some benthic organisms, such as hard clams and soft-shell clams, are economically important. Others, such as polychaete worms and shrimp-like crustaceans, contribute significantly to the diets of economically important blue crabs and bottom-feeding juvenile and adult fish such as spot, croaker, striped bass, and white perch.

The objectives of the Chesapeake Bay Estuarine Benthic Macroinvertebrate Monitoring Program are:

1. To characterize the health of regional areas of the lower Chesapeake Bay as indicated by the structure of the benthic community.
2. To conduct trend analyses on long-term data, at fixed- point stations, to relate temporal trends in the benthic communities to changes in water and/or sediment quality. The trend analyses will be updated annually as new data are available.
3. To warn of environmental degradation by producing an historical data base that will allow annual evaluations of biotic impacts by comparing trends in status within probability-based strata and trends at fixed-point stations to changes in water and/or sediment quality.

21 fixed-point stations are sampled one time per year (September) and there is one probabilistic summer sampling per year.

Contact: For further information on the Estuarine Benthic Macroinvertebrate Monitoring Program contact:

Cindy Johnson
629 East Main Street
Richmond, Virginia 23219
(804) 698-4385
cindy.johnson@deg.virginia.gov

CHAPTER 3.4 BEACH MONITORING PROGRAM - VIRGINIA DEPARTMENT OF HEALTH

Introduction

The “Beaches Environmental Assessment and Coastal Health (BEACH) Act” of 2000 amended Section 303 of the Federal Water Pollution Control Act (33 U.S.C. 1313) by specifying monitoring and reporting requirements for pathogens and pathogen indicators in coastal recreational waters for the purpose of protecting public health and welfare. One requirement of this Act was the publication of a list of “discrete coastal recreation waters adjacent to beaches or similar points of access that are used by the public.” The resultant “[National List of Beaches](http://water.epa.gov/type/oceb/beaches/list_index.cfm)” [http://water.epa.gov/type/oceb/beaches/list_index.cfm] was originally published by the U.S. EPA in 2004, and most recently in 2010. A current list of the beaches monitored in Virginia is available and cited below. The requirements of the BEACH Act apply only to states and tribes that have coastal recreational waters, defined by the Clean Water Act (Section 303(c) as the “...Great Lakes and marine and estuarine coastal waters that are designated by a state or tribe for use for swimming, bathing, surfing, or similar water contact activities...”

Virginia’s BEACH Monitoring Program [www.vdh.virginia.gov/epidemiology/DEE/BeachMonitoring] was initiated in 2002 by the Division of Environmental Epidemiology (DEE) of the Virginia Department of Health (VDH). In addition to the immediate reporting and public notification requirements relative to swimming advisories, results obtained by the VDH are communicated to DEQ for inclusion in the agency’s biennial 305(b)/303(d) Water Quality Assessment Reports. The specific 305(b) assessment methodologies for using (1) swimming advisories and/or (2) the enterococci concentration data from the BEACH Monitoring Program were discussed by VDH and DEQ. The final decision on appropriate methodologies is incorporated into the 2008 Assessment Guidance Manual for the Integrated 305(b)/303(d) Report.

The BEACH Monitoring Program in Virginia is designed to provide seasonal monitoring of coastal and Chesapeake Bay beaches within the Commonwealth. A public bathing beach is defined by the Code of Virginia (1980, c.428, section 10-217, 10.1-705) as “a sandy beach located on a tidal shoreline suitable for bathing in a county, city or town and open to indefinite public use.” Based on these characteristics, 47 public beaches were identified prior to December of 2003, by which time their locations were communicated to EPA for the National List of Beaches. As of July 2004, these beaches were being monitored by the BEACH Program [VDH Beach Monitoring](#). Currently, 46 beaches in Virginia are monitored by the BEACH Program. The rationale for identifying and enumerating individual beaches is discussed below, in the section on ‘siting.’ The localities participating in this program include the cities of Virginia Beach, Norfolk, Hampton, and Newport News, as well as the counties of Mathews, York, King George, Gloucester, Northampton, and Accomack.

Purpose

The purpose of the program is to monitor fecal contamination of coastal beaches in an effort to reduce the risk of swimmers contracting disease or infection. Weekly monitoring is conducted to determine if levels of fecal indicator bacteria (enterococci) meet Virginia’s Water Quality Standards as described in Section 9 VAC 25-260 of the Virginia Administrative Code. The Standards are provisions of state law which consist of designated uses for the waters of the Commonwealth to protect public health or welfare, enhance the quality of water, and serve the purposes of the State Water Control Law and the Federal Clean Water Act.

Monitoring Design and Station Siting

The number of sampling stations at a beach is based on EPA guidance available at the following website: <http://www.epa.gov/waterscience/beaches/grants/guidance/index.html>. The rationale for siting and enumerating individual beaches is based on beach size and whether (1) it is small and is treated as a single entity for swimming advisories, or (2) if it is more extensive and individual sections may be closed

independently. In summary, the current list of responsible health districts and beaches includes:

Rappahannock Health District (Fairview Beach) - 1 beach
Peninsula Health District (Newport News, York) - 5 beaches
Hampton City Department of Health - 3 beaches
Norfolk Department of Public Health - 10 beaches
Virginia Beach - 22 beaches
Three Rivers Health District (Gloucester, Mathews) - 2 beaches
Eastern Shore Health District (Accomack, Northampton) - 3 beaches

Total = 46 beaches

Samples are taken in the middle of a typical bathing area. If the beach is short, samples are taken at a point corresponding to each lifeguard chair or one sample for every 500 meters of beach. Sample results from several sites at the same beach may be united into a single arithmetic average for comparison with the Water Quality Standard and evaluation for swimming advisories, see below. If the beach is long (more than 5 miles) samples are spread out along the entire beach (e.g., Virginia Beach, which is 24 miles long, has 22 sampling stations spaced at least one mile apart). Locations of sites are identified by coordinates of latitude and longitude and remain uniform from year to year in order to maintain a permanent, long-term database on beach water quality.

The most updated information relative to the BEACH Monitoring Program, including maps of sampling sites, historical results, and swimming advisories, may be found on the [VDH BEACH Monitoring website](http://www.vdh.virginia.gov/epidemiology/DEE/BeachMonitoring/data) [http://www.vdh.virginia.gov/epidemiology/DEE/BeachMonitoring/data].

Frequency

Beaches are sampled for fecal indicator bacteria on a weekly basis from mid-May through September. When the Water Quality Standard at a specific beach is exceeded, or when the results of bacterial analysis are inconclusive, follow-up sampling is repeated as soon as possible.

Sampling

As per EPA guidance, samples are collected 0.3 meters below the surface in water knee-deep water (approximately 0.5 meters). VDH's 2012 Quality Assurance Project Plan provides general guidelines for sampling procedures. Samples are placed on ice and are delivered to the laboratory for processing within six hours of collection.

Samples are collected on the regular monitoring day, rain or shine, unless conditions are dangerous to sampling staff. If a decision is made not to sample because a violation of the standard is expected (e.g., heavy storm drain overflow), the beach is posted with a swimming advisory. Samples are collected and transported in the same way at all sites. All the samples are grab samples, using sterile bottles that are supplied by the laboratory performing analysis.

When continued exceedances of the water quality standard occur at monitoring locations, samples may be collected for microbial source tracking analysis by the Department of Crop and Soil Sciences at Virginia Polytechnic Institute and State University. The results of this analysis provide an indication of the source of fecal pollution. Varying sources of fecal pollution have shown to provide different levels of health risk to water users. Also, some sources of fecal pollution can be remediated.

Duration

Beach monitoring sites are considered permanent, fixed sites of the VDH BEACH Monitoring Program. Sampling will continue as long as funding is available. As mentioned above, the sampling is conducted from mid-May through the September swimming season.

Core and Supplemental Water Quality Indicators

The fecal indicator organism used for estuarine and marine beaches are bacteria of the genus *Enterococcus*. Laboratory analysis of enterococci in beach water samples is conducted using EPA approved methods. Additional measurements of air and water temperature, turbidity, dissolved oxygen, pH and salinity are also taken at beach sites during each visit.

Quality Assurance

VDH's Quality Assurance Project Plan was updated and approved by EPA in November 2012. Sampling methods are based on sections 9060 and 9060B of Standard Methods for the Examination of Water and Wastewater (APHA 2012). Standard procedures for laboratory analyses of water samples for enterococci are produced by the laboratories performing the service and are also included in the Quality Assurance Project Plan.

Annual training is provided for all field personnel and their supervisors. Training consists of sample collection and handling, data management, results interpretation, operation and calibration of equipment, and current program issues, updates, and quality assurance objectives.

Data Management

VDH receives weekly results from laboratories by email, fax, and/or conventional mail. Timely data submission is emphasized so that the VDH BEACH Monitoring website can be updated as soon as results are available. Timely data submission is mostly critical when exceedences of the Water Quality Standard occur and swimming advisories need to be issued. Upon receipt of results, VDH local health district staff enters laboratory results into a VDH database. When results are entered, swimming advisories are posted on VDH's BEACH Monitoring website for public notification.

Data are periodically sent to EPA, via CDX for STORET, in an XML schema utilizing formats specified in [EPA's Beach Monitoring Data User Guide](#).

Data Analysis/Assessment

Swimming Advisories: VDH compares beach water sample results with Virginia's Water Quality Standard for enterococci. The results from several simultaneously collected samples at the same beach may be united into a single arithmetic average for comparison with the Standard, and for subsequent evaluation for issuing swimming advisories. The Single Sample Maximum for enterococci is 104 colony forming units (cfu)/100ml. Samples above this level are in violation of the Virginia Water Quality Standards. One sample exceedence of the Single Sample Maximum standard is sufficient to issue a swimming advisory.

If there is a violation of the Standard, the beach is posted with a swimming advisory sign and procedures for contacting the locality where the beach is located are followed. A press release is issued to notify the public, and a follow-up water sample is collected and delivered to the lab as soon as possible. Procedures for this process are documented in the VDH's Quality Assurance Project Plan.

305(b)/303(d) Assessment and Reporting: The specific 305(b) assessment methodologies for using (1) swimming advisories and/or (2) the enterococci concentration data from the BEACH Monitoring Program was discussed by VDH and DEQ. As previously stated, the final decision on appropriate methodologies is

incorporated into the DEQ Assessment Guidance Manual for the 2012 Integrated 305(b)/303(d) Report.

Reporting

If sample results exceed the Water Quality Standard, the beach is posted with a swimming advisory sign, the public is notified through press releases to local newspapers, and an advisory is posted on the [VDH Beach Monitoring website](http://www.vdh.virginia.gov/Epidemiology/dee/beachmonitoring/) [http://www.vdh.virginia.gov/Epidemiology/dee/beachmonitoring/].

Sample results and public notification data are submitted to EPA annually as required. Data collected by the BEACH Monitoring Program are also communicated to DEQ for use in the agency's biennial Integrated 305(b)/303(d) Report.

Programmatic Evaluation

VDH participates in biweekly conference calls and annual meetings with EPA to review the BEACH Monitoring Program in Virginia. The program is grant funded, and reviews of the yearly proposals, progress reports, and database submissions are mechanisms for programmatic evaluation by EPA. Within VDH, there is routine communication between the Division of Environmental Epidemiology and the participating health districts, and weekly reviews of data from each participating health district are performed by VDH's BEACH Coordinator and/or support staff.

General Support and Infrastructure Planning

The BEACH Monitoring Program is a federally funded program. Yearly budgets are prepared well in advance to meet proposal submission deadlines established by EPA. Future changes in methodologies will depend upon EPA recommendations, and expansion of the current program may occur in response to the opening of new public beaches or their identification by local health districts.

Contact: For further information on the BEACH Monitoring Program contact:

Matt Skiljo
Waterborne Hazards Control Program Coordinator
VDH, Office of Epidemiology
109 Governor Street, 417
Richmond, Virginia 23219
(804) 864-8128
Matthew.Skiljo@vdh.virginia.gov

CHAPTER 3.5 CITIZEN AND NON-AGENCY WATER QUALITY MONITORING PROGRAM

Citizen water quality monitoring has been a stewardship activity in Virginia for many years. As both the volume and quality of water monitoring data collected by entities other than the Virginia Department of Environmental Quality (DEQ) has increased, so has the desire by many of these 'non-agency' organizations for DEQ to use submitted data for more than background information in Virginia's water quality assessments. Since 1999, the agency has encouraged citizen water quality monitoring by providing technical and, whenever possible, financial support. In addition to support for citizen monitoring, the agency has been actively attempting to expand our partnerships with an increasing number of other water quality monitoring programs that operate independently of DEQ.

Starting with the 2004 water quality assessment report, DEQ began using chemical monitoring data collected by citizen groups and other non-agency sources providing such data met DEQ Quality Assurance and Quality Control (QA/QC) protocols for determination of attainment of Water Quality Standards. This QA/QC process confirms whether citizen organizations and other non-agency data sources are using the same or similar sampling and testing methods that DEQ uses, ensuring that comparable data are used in any applications that include data from these sources.

In August 2004 DEQ created the Water Quality Data Liaison staff position. The purpose of the position is to provide guidance and technical support to citizen monitoring organizations, facilitate communication among citizen and non-agency water monitoring organizations, promote establishing new monitoring groups, and increase the amount and improve the quality of data shared with DEQ.

Citizen Monitoring:

Citizens of the Commonwealth monitor streams, lakes, and estuaries for a variety of parameters depending upon the goals of their own programs. Common ambient measures include many of the following physical and chemical parameters: water temperature, pH, dissolved oxygen, nutrients (various forms of nitrogen and phosphorus), or suspended solids in the water column. Biological parameters measured by citizen monitors often include benthic macroinvertebrates, *E. coli* bacteria, or chlorophyll *a*. Many of these parameters are routinely monitored by DEQ.

The Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America (VA SOS) took the lead in working with DEQ and the Department of Conservation and Recreation (DCR) to develop a statewide citizen monitoring program. This started with three separate letters of agreement signed by each agency in 1998 and was furthered by a three-way agreement signed in 1999. The latest version of the agreement, signed in October 2006, includes the Alliance for the Chesapeake Bay, Virginia Citizens for Water Quality and the Virginia Water Monitoring Council in addition to the original signatories from 1999.

Citizen monitoring efforts in Virginia received an additional boost in 1999 when the Virginia General Assembly approved a budget amendment to create the Citizen Water Quality Monitoring Grant Program in order to provide general funds, when available, for citizen monitoring activities. Since 1999, the Citizen Monitoring Grant Program has provided funding to over 100 different organizations. The financial support provided by the Commonwealth via this grant program has led to an increase in the quality and quantity of citizen-collected data submitted to DEQ and has proved an effective way for DEQ to encourage citizen volunteer groups to generate DEQ-approved water quality data. The grant requires recipients to submit Quality Assurance Project Plans (QAPP) and to follow DEQ approved procedures. In return, the grant recipient receives a grant award to help cover many of the costs associated with their monitoring programs.

In 2002, the Virginia General Assembly passed legislation that established the Virginia Citizen Water

Quality Monitoring Program in the Code of Virginia ((§62.1-44.19:11). This legislation was later amended in 2007 under House Bill 1859 to establish a goal for DEQ to encourage citizen volunteers to monitor 3,000 stream miles by 2010. This goal was met during the 2010 305(b)/303(d) Integrated Report where 3,499.45 stream and river miles were monitored by citizen groups.

Quality Assurance:

Currently, DEQ has contacts with approximately 180 citizen monitoring organizations. Of these, 120 groups submitted water quality data for review and consideration for use by DEQ in this assessment. However, not all citizen monitoring data submitted could be used in this assessment report. However, all citizen-generated data is important to DEQ and helps to characterize the quality of Virginia's waters.

Data used in this report were collected under documented protocols, standard operating procedures, and QA/QC methods as approved by DEQ for water quality assessment. Data collected at unconfirmed locations by DEQ or where sampling occurs on waters not publically accessible such as on privately owned lakes were not used in this assessment. Data collected by citizen volunteers not used directly for this assessment report will still be used by DEQ, and other agencies, to help prioritize future monitoring and restoration work. Additional information associated with assessing citizen monitoring data is available in the 2014 Water Quality Assessment Guidance Manual available at the EQ website: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityAssessments.aspx>

In order to assist citizen monitoring organizations with developing their monitoring programs, the *2003 Virginia Citizen Water Quality Monitoring Methods Manual* was revised in October 2007. The manual provides additional guidance on acceptable QA/QC procedures and protocols. A copy of this manual is available on the DEQ website: <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring/Guidance.aspx>

As outlined in the *Virginia Citizen Water Quality Monitoring Methods Manual*, DEQ has three levels to determine the quality of citizen and other non-agency water monitoring data. These levels increase in rank from Level I to Level III based on increasing levels of DEQ approved QA/QC protocols. Definitions of each level and how groups can achieve each of them are outlined below.

Level I - Not approved by DEQ for assessment. There is no Quality Assurance Project Plan (QAPP) or Standard Operational Procedures (SOP) on file. Monitoring and/or laboratory analysis does not follow DEQ sampling methods or quality assurance protocols or monitor for parameters that do not have a Virginia Water Quality Standard (<http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityStandards.aspx>).

- Data used by DEQ to identify sites that may require DEQ to perform follow-up monitoring.
- Data used for educational or outreach purposes.
- Data can notify DEQ of significant pollution events for rapid agency response.

Level II - Partially approved by DEQ. May be using a monitoring method similar to DEQ protocols but not fully approved by DEQ due to difference in sampling or testing methodology. The monitoring group may have a DEQ approved QAPP and/or SOP on file.

- All uses as stated in Level I
- Used for 305(b) assessment to identify possible waters with observed effects or waters that appear to be healthy but will need DEQ monitoring data to confirm status (Category 3C or 3D).

Level III - Approved by DEQ. Group follows DEQ testing protocols and quality assurance. Field sampling and laboratory testing protocols are approved by DEQ or DEQ approved accrediting authority. Group possesses a DEQ approved QAPP and SOP with no deviation from DEQ approved standardized methods (EPA methods, Standard Methods, etc). Finally, the group must provide calibration and quality control associated information to DEQ when submitting data. This information must meet the specific criteria stated in the QAPP.

- All uses as stated in Level II
- DEQ views this level of data as if DEQ had collected and analyzed the sample. Data that meets Level III criteria will be used in the 305(b) water quality assessment and for 303(d) listing/delisting of impaired waters.

As of December 2012, DEQ had awarded Level III status to 40 of the 120 citizen monitoring organizations who have submitted water quality data to the agency. The desire of many groups to have DEQ use their data, the continued efforts by DEQ to help citizen groups to match DEQ protocols, and the Citizen Monitoring Grant Program, have helped to increase the number of Level III data submissions.

For the 2014 assessment report, DEQ received citizen monitoring data from 1,689 sites. None of these sites were considered Level I for all submitted parameters, 773 sites met Level II, and 916 sites met Level III for at least one water quality parameter. Of these 1,689 Level II and III stations, 30 sites had either missing sample site coordinates or were located near non representative locations such as at permitted wastewater outfalls. This assessment cycle marks the highest ever number of Level III citizen volunteer stations included in the Virginia 305(b)/303(d) Integrated Report.

Summary of Citizen Data Submissions: For the 2014 305(b)/303(d) Integrated Water Quality Assessment Report, the following citizen monitoring organizations submitted water quality data to DEQ:

Alliance for the Chesapeake Bay	Goose Creek Association	Prince William SWCD
Black Water/Nottoway Riverkeeper	Historic Green Springs Inc.	Randolph Macon College
Chesapeake Beach Civic League	Hoffler Creek Wildlife Refuge	RappFlow
Chesterfield WaterTrends	Isle of Wight Ruritan Club	Rippon Middle School
Clean Virginia Waterways	John Marshall SWCD	Riverine Chapter VMN
Coast Guard Auxiliary Flotilla 33	Lake Anna Civic Association	Roanoke Valley Trout Unlimited
Cowpasture River Preservation Association	Lake Monticello Owners Association	Rockfish Valley Foundation
Cubitt Creek Monitors	Leesville Lake Association	Save Little Pimmit Run
Dividing Creek Association	Lord Fairfax SWCD	Smith Mountain Lake Association
Fairview Beach Residents Association	Loudoun Watershed Watch	Southern Appalachian Mountain Stewards
Four Creeks Monitors	McClure River Restoration Project	Southside SWCD
Friends of Blacks Run	Nansemond River Preservation Alliance	StreamWatch
Friends of Norfolk Environment	National Committee for the New River	Thomas Jefferson SWCD
Friends of the North Fork Shenandoah River	Nelson County Master Gardeners	Timberlake Homeowners Association
Friends of the Russell Fork	Phi Theta Kappa	Upper Tennessee River Roundtable
Friends of the Shenandoah River	Poquoson Citizens for the	Virginia Save Our Streams

Environment

George Mason High School

Potomac Appalachian Trail Club

**Pebble Creek Property Owners
Association**

The Alliance for the Chesapeake Bay submitted ambient (chemical and physical) data collected by the following affiliate organizations:

Elizabeth River Project	George Washington's Birthplace National Monument	Tidewater SWCD
Friends of the Rappahannock Chemical Monitoring Program	Isle of Wight Water Watchers	Tidewater Resource Conservation and Development Council
Friends of Stafford Creeks	Leesylvania State Park	

The Friends of the Shenandoah River submitted ambient (chemical and physical) data collected by the following affiliate organizations:

Augusta River Monitors	Friends of the North Fork Shenandoah River	Opequon Watershed Inc.
Friends of Page Valley	Friends of the Shenandoah River	Warren County Water Monitoring Group

The VA SOS program is the largest citizen and benthic macroinvertebrate monitoring program in Virginia. The VA SOS Modified Rocky Bottom Method protocol determines the benthic community health in higher gradient streams with riffles typical to those found in the western part of Virginia. DEQ and VA SOS consider the data submitted to be Level II because it provides general information on the overall health of a benthic community.

In response to requests from citizens located in the eastern part of Virginia, VA SOS also developed a protocol for low gradient, freshwater, non-tidal streams. At the time of this report, DEQ has not approved the low gradient freshwater streams for QA Level II or III.

The Virginia Save Our Streams Program of the Virginia Division of the Izaak Walton League of America submitted benthic macroinvertebrate data collected by the following affiliate organizations:

Albemarle County	Friends of the Rockfish Watershed	Patrick County Monitors
Amelia County Landfill	Goose Creek Association	Patrick County SWCD
Bluestone Watershed Committee	Grundy High School	Pedlar River Institute
Buchanan Citizens Action Group	Roanoke Valley Governor's School	Pound River Watershed Coalition
Buckingham Citizen Action League	Headwaters Association	Radford University Green Team
Clinch Coalition	Holston River Water Quality Monitors	RappFLOW
Clinch Valley SWCD	Hungry Mother State Park	Reston Association
Cowpasture River Preservation Association	Independence High School	Rivanna Conservation Society
Culpeper SWCD	John Marshall SWCD	Riverine Chapter of the Virginia Master Naturalists
Dan River Basin Association	Kittrell Stream Team	Roanoke Valley Monitors
Douthat State Park	Lake Anna Civic Association	Smith Mountain Lake Association
Elliott Creek Watershed Protection	Lord Botetourt High School	StreamWatch

Council		
Emory and Henry College	Loudoun Watershed Watch	Upper James River Roundtable
Environmental Education Center	Loudoun Wildlife Conservancy	Upper Rappahannock Watershed Stream Monitoring Program
Environmentally Concerned Citizens Organization	Maury River Middle School	Upper Tennessee Roundtable
Franklin County Master Naturalists	Maury River Monitors	Virginia Run Home Owners Association
Friends of Page Valley	Mountain Stream Stewards	Virginia's Explore Park
Friends of the North Fork of the Shenandoah River	Middle River Monitors	Virginia Tech
Friends of the North River	New River SWCD	Walker Creek Watershed Group
Friends of the Rappahannock River	North Cross School	Warren County Chapter of the Izaak Walton League
Friends of the Pedlar River	Northern Virginia SWCD	Washington and Lee University

Below is an alphabetical summary of the water quality data contributions by citizen monitoring organizations that DEQ included in this report. Additional information is available in a table at the end of this summary and in Appendix D.

The **Alliance for the Chesapeake Bay** (ACB) coordinates with affiliate organizations in the eastern half of Virginia. ACB volunteers monitor a conventional suite of ambient parameters including dissolved oxygen, temperature, pH, salinity, and water clarity. Trained volunteers monitored at 67 stations and collected 2,443 sample events during the six-year data window for this report. Most dissolved oxygen and temperature data met DEQ quality assurance criteria to assess water quality conditions. Starting in 2011, ACB upgraded their pH testing equipment from colorimetric field kits to pH meters to increase the quality of pH data collected by their volunteers. Of the submitted data, 6 sample sites composed of 46 sample events were not included in this assessment report due to having an unknown station location.

The **Blackwater/Nottoway Riverkeeper Program** (BNRP) is an organization that helps educate and promote environmental stewardship in the Blackwater and Nottoway Rivers. As part of this education and stewardship effort, the BNRP conducts routine monitoring for temperature, pH, dissolved oxygen, nutrients, and *E. coli* at 10 stations in several counties in southeastern Virginia. DEQ has received 189 sampling events for the 2014 305(b)/303(d) Integrated Report. DEQ will use this data in the assessment to determine if follow-up monitoring is needed.

The **Chesapeake Beach Civic League** (CBCL) conducts routine monitoring for temperature, pH, *E. coli*, and nutrients. The CBCL monitors at 14 locations covering 180 sampling events on 5 privately owned lakes. Because the lakes are not publically accessible, they are not included in the 305(b)/303(d) assessment report. However, DEQ has been working with the volunteers to provide an informal assessment of water quality conditions at each of the monitored lakes. This information is being used to help educate homeowners on sustainable land use practices.

Chesterfield WaterTrends, a water monitoring program of the Friends of Chesterfield's Riverfront, conducts routine monitoring in the James River for temperature, pH, dissolved oxygen, *E. coli* bacteria, and turbidity. Chesterfield WaterTrends has 47 samplings stations. DEQ has received 1803 sampling events for the 2014 305(b)/303(d) Integrated Report. DEQ will use this data in the assessment to determine if follow-up monitoring is needed.

Clean Virginia Waterways, in partnership with Longwood University, collected 726 *E. coli* samples from

21 stations along the Appomattox River as part of the Appomattox River Water Quality Monitoring Program. Upon review of sampling and laboratory procedures, DEQ will assess the *E. coli* data.

Coast Guard Auxiliary Flotilla 33, a volunteer branch of the United States Coast Guard, conducts routine monitoring for depth, temperature, pH, dissolved oxygen, and conductivity. They sample at 7 stations in the Chesapeake Bay stations. DEQ has received 49 sampling events for the 2014 305(b)/303(d) Integrated Report. DEQ will use this data in the assessment to determine if follow-up monitoring is needed.

The **Cowpasture River Preservation Association** collects *E. coli* samples using the Coliscan Easgyel method. DEQ received data from 23 stations comprising of 400 samples during this assessment cycle. Data will be used to determine additional monitoring locations by DEQ and help with TMDL implementation efforts.

The **Cubitt Creek Monitors** collected 70 samples for temperature and *E. coli* at 10 stations in Cubitt Creek. Submitted data will be used to determine the need for additional follow-up monitoring by DEQ.

The **Dividing Creek Association** (DCA) has been an active monitoring and stewardship organization located on Dividing Creek near Kilmarnock, Virginia. Since 2008, DCA has begun an enhanced monitoring program and submitted data from 52 stations consisting of 1193 sample events. By following DEQ recognized protocols, DEQ will utilize temperature, dissolved oxygen, and pH data for assessing the health of Dividing Creek. *E. coli* bacteria and water clarity data will be considered to justify the need for establishing follow up monitoring stations by DEQ.

Fairview Beach Residents Association collects *E. coli* samples using the Coliscan Easgyel method. DEQ received data from 69 stations comprised of 171 sampling events. The bacteria results will be used to determine additional monitoring locations by DEQ and help with TMDL implementation efforts.

Four Creeks Monitors collects *E. coli* samples using the Coliscan Easgyel method. DEQ received data from 16 stations comprised of 193 sampling events. Data will be used to determine additional monitoring locations by DEQ and help with TMDL implementation efforts.

The Friends of Blacks Run Greenway, in partnership with James Madison University and several local high schools, conducted an intensive *E. coli* monitoring program in Blacks Run using Coliscan test kits. This project was supported through DEQ in an effort to determine potential areas for restoration efforts as part of the Blacks Run TMDL IP. Volunteers collected 121 samples at 14 stations and DEQ will use this data to determine if follow-up monitoring is needed.

Friends of Norfolk Environment collected Enterococcus samples at 11 stations comprising of 132 sample events during 2010. Old Dominion University performed the analysis and the data will be used by DEQ to assess recreation related water quality standards at the monitoring locations.

Friends of the North Fork of the Shenandoah River (FNSR) are an affiliated group with the Friends of Shenandoah River. Along with the routine monitoring done under the larger Friends of Shenandoah River and Virginia Save Our Streams programs, FNSR collected 98 nutrient, *E. coli* and field parameter samples at 8 stations. Of the submitted data, 2 sample sites composed of 16 sample events were not included in this assessment report due to being located within VPDES permitted mixing zones.

Friends of Russell Fork monitored 19 stations and collected 324 *E. coli* and temperature readings. The data will help DEQ determine the need for additional monitoring by DEQ in the waterbodies sampled by this group.

The **Friends of the Shenandoah River** (FOSR) monitors ambient water quality for dissolved oxygen, pH, temperature, ammonia, nitrate, and orthophosphate in the Shenandoah River subbasin. From 2007 to 2012, FOSR collected 12,002 sample events from 233 stations. Of the submitted data, 17 sample sites composed of 450 sample events were not included in this assessment report due to missing site

coordinates or located within VPDES permitted mixing zones. DEQ is assessing FOSR data for ammonia, dissolved oxygen, *E. coli* bacteria, pH, and temperature in sampled waterbodies. The parameter nitrate is only assessed in waters designated for drinking water in this report as nitrate only has a drinking water quality standard.

George Mason High School students collected *E. coli* samples using the Coliscan Easygel method at four stations. From the start of the monitoring in February 2009 to December 2012, the students collected 74 samples. The data will help DEQ in identifying areas for future agency sampling.

The **Goose Creek Association** (GCA) collected 519 water chemistry and *E. coli* samples at 21 stations over the course of this reporting period. GCA volunteers also collected benthic macroinvertebrate data using Virginia Save Our Streams protocols and submitted to DEQ via Virginia Save Our Streams. DEQ will use the dissolved oxygen, pH and *E. coli* data to determine if follow-up monitoring is needed. Temperature data will be assessed to indicate if the sampling stations are showing water quality attainment or impairment.

The **Historic Green Springs, Inc.** conducted monitoring in the York River Basin for temperature, pH, nutrients, and total suspended solids. Trained volunteers monitored seven stations and conducted 79 sampling events at 7 stations in this basin during the data window for this assessment. Temperature, dissolved oxygen, nutrient data meeting QA/QC requirements were used to assess water quality. Total suspended solids, and pH data was used to determine if follow-up monitoring is needed.

Hoffler Creek Wildlife Foundation volunteers collected 72 dissolved oxygen, pH, and temperature samples at one site during 2009 to 2012. Data is being used to determine the need for future follow up sampling by DEQ.

The **Isle of Wight Ruritan Club** has been conducting water quality sampling at three stations. From February 2007 to December 2012, volunteers monitored on 160 occasions at 12 stations for temperature and dissolved oxygen to assess water quality. The additional parameters monitoring including pH and *E. coli* bacteria will be used by the agency to identify need to do follow up monitoring.

The **John Marshal Soil and Water Conservation District** (JMSWCD) conducted 1,677 sampling events at 35 sites in Fauquier County. JMSWCD collected samples to test for *E. coli* using Coliscan and sampled for temperature, dissolved oxygen, pH, and nutrients. The purpose of monitoring was to track TMDL implementation efforts and identify sites that would benefit from BMP installation. DEQ included the submitted data included the Coliscan results for Category 3C and 3D to determine if follow-up monitoring is needed.

The **Lake Anna Civic Association** collected samples on Lake Anna and its tributaries using a conventional suite of ambient parameters including dissolved oxygen, temperature, pH, *E. coli*, total phosphorus, and water clarity. Trained volunteers monitored 45 stations and conducted 2073 sampling events in this basin during the data window for this report. Of the submitted data, 5 stations comprising of 477 sample events were not assessed as they are located in VPDES permitted mixing zones. DEQ is assessing the remaining data for chlorophyll a, dissolved oxygen, pH, temperature, total phosphorous, and *E. coli* for this report.

The **Lake Monticello Owners Association** monitors 12 stations around Lake Monticello, a privately owned lake in the Rivanna Watershed. From May 2007 to October 2012, the volunteers monitored 316 sample events sampling for pH, dissolved oxygen, temperature, conductivity, nutrients, *E. coli* bacteria, and water clarity. Because the monitoring is on a lake not considered a publicly accessible waterbody, DEQ did not assess the data as part of this 305(b)/303(d) report. However, DEQ has conducted a review of the results and is working with the association to provide guidance to modify their monitoring program and provide an informal water quality assessment of lake conditions.

The **Leesville Lake Association** (LLA) include a group of volunteers committed to monitor and promote the environmental needs of Leesville Lake located just downstream of Smith Mountain Lake. LLA

volunteers in partnership with Liberty University have monitored 12 stations covering 1,232 sample events. Though this monitoring, DEQ will assess data for temperature, dissolved oxygen, and pH. In addition, DEQ will use provided *E. coli* data via the Coliscan Easygel method to determine if follow-up bacteria monitoring is necessary.

The **Lord Fairfax Soil and Water Conservation District (LFSWCD)** monitored for *E. coli* bacteria levels along Holman's Creek in Shenandoah County. LFSWCD staff and volunteers used the Coliscan test kits to determine general trends in *E. coli* levels at 12 sites comprising of 109 sample events. The purpose of this monitoring was to track TMDL implementation efforts and identify sites that would benefit from BMP installation. DEQ will use the results to determine if follow-up monitoring is needed.

Loudoun Watershed Watch collects *E. coli* samples using the Coliscan Easygel method and benthic macroinvertebrate results using the Virginia Save Our Stream method in the Potomac watershed. DEQ received data from 14 stations comprised of 526 sampling events. Data will be used to determine additional monitoring locations by DEQ and help with TMDL implementation efforts.

The **McClure River Restoration Project (MRRP)** is conducting an intensive *E. coli* monitoring program in the McClure River watershed. DEQ has received data from 43 stations composed of 637 sample events during the assessment cycle. Based on reviewing sampling and laboratory protocols, DEQ will use the data to assess water quality.

Nansemond River Preservation Alliance conducts routine monitoring for temperature, dissolved oxygen, salinity, water clarity, and *E. coli* at 7 stations in the James River. DEQ has received data from 84 sampling events and will use the results to assess water quality.

The **National Committee for the New River (NCNR)** began monitoring at 37 locations in the New River watershed in May of 2008. Since then, NCNR volunteers have monitored 472 sample events. Volunteers sampled for temperature, dissolved oxygen, pH, *E. coli* bacteria, and water clarity. DEQ will use the temperature, and dissolved oxygen to assess water quality at these locations. The *E. coli* and pH results will be used to determine if follow-up monitoring is necessary due to the volunteers using the Coliscan Easygel method.

The **Nelson County Master Gardeners** monitored 13 stations in the Rockfish and Tye River watersheds. Since June 2008, the group has monitored on 70 occasions using the Coliscan Easygel method to monitor for *E. coli* bacteria. DEQ will use the provided Coliscan data to determine if follow-up sampling is needed by the agency.

The **Phi Theta Kappa Chapter of the Blue Ridge Community College** collected pH, *E. coli*, and temperature data from two stations in 2010. Results from the 24 sample events will be used to determine the need for additional agency sampling for future monitoring.

Poquoson Citizens for the Environment (PCE) has been conducting temperature, pH, and *E. coli* sampling at 32 stations since January 2008. This sampling program sampled 408 times and results to DEQ. Based on the protocols used by PCE, DEQ will use the pH and temperature data to assess water quality and *E. coli* data to determine if follow up monitoring is necessary due to using the Coliscan Easygel method.

The **Potomac Appalachian Trail Club** collected benthic macroinvertebrate, water temperature, and pH data at seven locations from March 2007 to October 2008. Volunteers collected 17 samples at these locations during this sampling period. DEQ will use the macroinvertebrate, temperature, and pH data to determine if follow-up monitoring is necessary.

The **Prince William Soil and Water Conservation District** collected 139 *E. coli* samples at 12 locations using the Coliscan Easygel method. The data is being used by DEQ to determine if follow-up monitoring is necessary under the Category 3C/3D portion of the assessment report.

Randolph Macon College located in Ashland, Virginia, has used Coliscan test kits to monitor nearby Mechumps Run. Students collected 226 *E. coli* samples at 30 sites in an effort to assist DEQ in finding areas of high *E. coli* concentrations and to track TMDL implementation efforts. Based on training and technical assistance provided by DEQ, the agency is using the data to determine if follow-up monitoring is needed.

The **Rappahannock Friends and Lovers of Our Watershed** (RappFLOW) performed 24 sample events at 12 stations for temperature, and *E. coli* bacteria from April to June 2009. Upon review of calibration logs and other quality assurance materials, DEQ used the data in this assessment to determine if follow-up monitoring is needed.

Rippon Middle School collected *E. coli* samples using the Coliscan Easgyel method in the Potomac/Shenandoah River. DEQ received data from 6 stations comprised of 21 sampling events. Data will be used to determine additional monitoring locations by DEQ and help with TMDL implementation efforts.

The **Riverine Chapter of the Virginia Master Naturalists** began monitoring in March 2009. Volunteers collected 38 samples for dissolved oxygen, *E. coli*, pH, and temperature at six stations. Submitted data will be used by DEQ to determine the need for future agency sampling.

Roanoke Valley Trout Unlimited collects temperature and *E. coli* samples using the Coliscan Easgyel method in the Roanoke River. DEQ received data from 10 stations comprised of 30 sampling events. Temperature data will be used for assessment. The *E. coli* results will be used to determine the need for additional agency sampling.

The **Rockfish Valley Foundation** collected 42 *E. coli* samples using the Coliscan Easygel method at six locations during 2007. The results will be used by DEQ to determine if additional follow-up monitoring is needed on the South Fork Rockfish River located in Nelson County.

Save Little Pimmit Run is a small neighborhood organization committed to preserving the health of Little Pimmit Run in Arlington and Fairfax Counties. From February to July 2008, volunteers collected 22 *E. coli* samples at five sample sites using the Coliscan Easygel method. Based on the data, DEQ will evaluate the *E. coli* results to determine if additional follow-up sampling is needed.

The **Smith Mountain Lake Association** (SMLA) and Ferrum College have partnered for many years to monitor water quality in and around Smith Mountain Lake. Since 2007, SMLA has enhanced their monitoring program to generate Level III data for temperature, dissolved oxygen, pH, and *E. coli* bacteria. Level II data was provided for total phosphorous and chlorophyll a. From May 2007 to September 2009, SMLA performed 4,912 sample events at 141 stations. DEQ will use the temperature, dissolved oxygen, pH, and *E. coli* data to assess water quality. Nutrient and chlorophyll a data will be used to determine if DEQ should perform follow-up monitoring at selected sites.

Southern Appalachian Mountain Stewards collected five selenium samples at five stations in the Tennessee River to identify potential impact of nearby coal mining operations. DEQ will use the submitted data to assess water quality.

Southside Soil and Water Conservation District located in Charlotte and Lunenburg Counties collected 762 *E. coli* samples at 21 locations using the Coliscan Easygel method. Data provided to DEQ was used to determine if follow-up monitoring is necessary under the Category 3C/3D portion of the assessment report.

StreamWatch submitted benthic macroinvertebrate and *E. coli* data using the Coliscan Easygel method. Volunteers collected 1,257 samples at 111 stations located around the Rivanna subbasin. Based on a validation study performed between StreamWatch enhanced benthic monitoring program and DEQ benthic metrics, it was determined that StreamWatch data is of equal quality to DEQ benthic monitoring protocol. DEQ will use the submitted benthic data to assess water quality. *E. coli* data submitted will be

used to determine if DEQ should perform additional bacteria monitoring.

Thomas Jefferson Soil and Water Conservation District volunteers collected 305 *E. coli* samples at 11 sites using the Coliscan Easygel method. Data provided to DEQ was used to determine if follow up monitoring is necessary under the Category 3C/3D portion of the assessment report.

The **Timberlake Homeowners Association** monitors a privately owned lake just outside of Lynchburg. During this assessment period, volunteers collected dissolved oxygen, pH, temperature, nutrients, and *E. coli* data at 11 stations covering 77 sample events. Upon review of protocols and methods used by the volunteers, DEQ will assess water quality using data collected at the tributaries of this privately owned lake.

The **Upper Tennessee River Roundtable** (UTRR), collected *E. coli* samples using Coliscan at several creeks located around Wise, Virginia. This project was supported through DEQ in an effort to determine potential sources and areas for restoration efforts as part of the Three Creeks TMDL IP. Volunteers collected 54 samples at eight stations from January to August 2007. Based on the training and technical assistance provided by DEQ, the agency is incorporating the data into this report to determine if follow-up monitoring is needed.

The **Virginia Save Our Streams Program** of the Virginia Division of the Izaak Walton League of America (VA SOS) coordinates with a number of affiliate organizations across Virginia. Trained VA SOS volunteers collecting benthic macroinvertebrate samples using the VA SOS Modified Rocky Bottom Method and submitted data from 351 stations with valid site coordinates composed of 1,696 sample events. DEQ will use SOS data to determine if follow-up monitoring is needed.

Pebble Creek Property Owners Association collected temperature and *E. coli* samples at 4 stations in the James River. DEQ received 44 sampling events and will use the information to determine if follow up monitoring is needed.

Table 3.5-1 Citizen Monitoring Data Considered for Assessment Level II and III

Citizen Monitoring Organization	Potomac/ Shenandoah		James		Rappahannock		Roanoke		Chowan		Tennessee		Chesapeake Bay		York		New		Big Sandy		Unknown/ VDPES		Total	
	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events
Alliance for the Chesapeake Bay	15	360	16	484	16	1129							10	191	4	233					6	46	67	2443
Black Water/Nottoway Riverkeeper									10	189													10	189
Chesapeake Beach Civic League													14	180									14	180
Chesterfield WaterTrends			47	1803																			47	1803
Clean Virginia Waterways			21	726																			21	726
Coast Guard Auxiliary Flotilla 33													7	49									7	49
Cowpasture River Preservation Association			23	400																			23	400
Cubitt Creek Monitors	10	70																					10	70
Dividing Creek Association													52	1197									52	1197
Fairview Beach Residents Association	69	171																					69	171
Four Creeks Monitors													16	193									16	193
Friends of Blacks Run	14	121																					14	121
Friends of Norfolk Environment			11	132																			11	132
Friends of the North Fork Shenandoah River	7	91																			2	16	9	107
Friends of the Russell Fork																			19	324			19	324
Friends of the Shenandoah River	225	11552																			17	92	242	11644
George Mason High School	4	74																					4	74
Goose Creek Association	21	539																					21	539
Historic Green Springs Inc.															7	79							7	79
Hoffler Creek Wildlife Refuge			1	72																			1	72
Isle of Wight Ruritan Club			7	101					5	59													12	160
John Marshall SWCD					35	1677																	35	1677
Lake Anna Civic Association															40	1596					5	477	45	2073
Lake Monticello Owners Association			12	316																			12	316
Leesville Lake Association							12	1232															12	1232
Lord Fairfax SWCD	4	109																					4	109

Loudoun Watershed Watch	14	526											14	526
McClure River Restoration Project						3	11					40	626	43 637

Citizen Monitoring Data Considered for Assessment: Level II and III Continued

Citizen Monitoring Organization	Potomac/Shenandoah		James		Rappahannock		Roanoke		Chowan		Tennessee		Chesapeake Bay		York		New		Big Sandy		Unknown/ VDPES		Total	
	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events
Nansemond River Preservation Alliance			7	84																			7	84
National Committee for the New River																	37	472					37	472
Nelson County Master Gardeners			13	70																			13	70
Pebble Creek Property Owners Association			4	44																			4	44
Phi Theta Kappa	2	24																					2	24
Poquoson Citizens for the Environment															32	408							32	408
Potomac Appalachian Trail Club	4	7	1	4	2	6																	7	17
Prince William SWCD	12	139																					12	139
Randolph Macon College															30	226							30	226
RappFlow					12	24																	12	24
Rippon Middle School	6	21																					6	21
Riverine Chapter VMN			6	38																			6	38
Roanoke Valley Trout Unlimited							10	30															10	30
Rockfish Valley Foundation			5	42																			5	42
Save Little Pimmit Run	5	22																					5	22
Smith Mountain Lake Association							141	4912															141	4912
Southern Appalachian Mountain Stewards											6	7											6	7
Southside SWCD							14	510	7	252													21	762
StreamWatch			111	1257																			111	1257
Thomas Jefferson SWCD			11	305																			11	305
Timberlake Homeowners Association							11	77															11	77
Upper Tennessee River Roundtable											8	54											8	54

Virginia Save Our Streams	163	959	55	130	28	106	85	462		13	27			4	9	3	3		351	1696				
Total number of stations/samples	575	14785	351	6008	93	2942	273	7223	22	500	30	99	113	2542	113	2542	41	481	62	953	30	631	1689	37974
Overlap Stations*	29		9		6																		44	
Net Unique Stations	546		330		87		273		22		30		85		113		41		62		30		1645	

* Overlap stations refer to stations monitored by two or more monitoring organizations. Often this is due to sampling for different parameters.

Other Non-Agency Water Quality Monitoring:

By broadening the scope of our data solicitation beyond citizen monitoring, DEQ is receiving water quality data from an expanding pool of government, private industry, and other non-citizen monitoring organizations. The guidelines for accepting these datasets are the same as with citizen monitoring data. Each organization must show documented sample collection and testing protocols and pass routine inspections and laboratory audits by the agency. Depending on the degree of compliance with the vetting of the sampling methods and test procedures, the data can either be used directly for assessment or provide locations to establish future DEQ sampling sites.

Prior to the 2004 assessment report, DEQ received water quality monitoring data from the United States Geological Survey (USGS). The data collected by the USGS follows strict adherence to EPA sampling methods and analytical procedures that are fully approved by DEQ. In addition, the United States Forest Service (USFS) routinely submits benthic macroinvertebrate data. The benthic data collected by the USFS follow standard benthic macroinvertebrate monitoring protocols that are similar to DEQ benthic monitoring methods.

Since the 2004 report, additional agencies have begun submitting water quality data for assessment. Most of the data submitted for the 2014 assessment report comes from various federal, state, and local government agencies and select academic institutions.

For the 2014 assessment report, DEQ received data from 19 non-agency organizations which monitored at 767 sample sites. Zero sites met Level I requirements, 34 met Level II and 723, up from 427 in the 2012 Report, met Level III for at least one water quality parameter. Of these 767 Level II and III stations, 7 sites had either missing sample site coordinates or were located near non representative locations such as at permitted wastewater outfalls.

The following private and government organizations submitted water quality data to DEQ:

Appalachian Electric Power	James City County Stormwater Division	Tennessee Valley Authority
Appalachian Technical Services, Inc.	National Park Service Assateague Island National Seashore	United States Forestry Service
City of Norfolk Department of Utilities	National Park Service Mid-Atlantic Monitoring Network	United States Geological Survey
City of Suffolk	National Park Service Northeast Coastal & Barrier Network	VDH Beach Program
Cumberland Resources Corporation	Occoquan Watershed Monitoring Laboratory	Wolf Creek Water Reclamation Facility
DCR Beach Program	Pocahontas State Park	
Edge Valley Preservation LLC	Page County Department of Environmental Services	

Below is an alphabetical summary of the water quality data from non-agency organizations that DEQ included in this report. Additional information is available in a table at the end of this summary and in Appendix D.

Appalachian Electric Power monitored ten stations in the Smith Mountain Lake as part of a study on levels of dissolved copper present in the water column resulting from algae control measures. AEP staff collected 60 samples at 10 locations from June 2007 to September 2009. DEQ will use this data to determine if copper levels are within acceptable aquatic life use criteria.

Appalachian Technical Services, Inc (ATS) is a private consultant firm hired to conduct benthic macroinvertebrate sampling in streams that receive discharges from coal mining operations. In 2011 ATS staff sampled at 155 stations in the Big Sandy and Tennessee Rivers collecting benthic macroinvertebrate samples on 266 occasions. Upon review of sample collection and identification protocols, DEQ will use the submitted data to assess aquatic life use at the sampled locations.

The **City of Norfolk** Department of Utilities monitored 18 stations in public drinking water reservoirs for temperature, pH, dissolved oxygen, conductivity and nutrients. DEQ received 7,557 sample events worth of water quality data and will assess for temperature, pH, dissolved oxygen, and nutrients.

The **City of Suffolk** monitored 18 stations along the lower Nansemond River for temperature, pH, *E. coli*, *Enterococcus*, TSS, salinity, and nutrients. DEQ received 320 sample events worth of data and will assess water quality conditions for temperature, pH, bacteria, and nutrients.

The **Cumberland Resources Corporation** collected 46 samples at 2 locations in the Big Sandy River as part of a study of impacts of coal mine discharges to local streams. These samples were to test levels of chloride and will be assessed to determine impacts to aquatic life use.

The **Department of Conservation and Recreation (DCR)** performs monthly fecal bacteria sampling at beaches located in state parks. During this assessment cycle, DCR staff collected 1,049 *E. coli* samples at 42 locations in the York, James, Roanoke, New and Tennessee Rivers. DEQ will assess the data to determine if bacteria levels impact recreational water quality standards.

The **Edge Valley Preservation LLC** is a real estate developer committed to preserving the rural nature of Bundoran Farm located near Charlottesville, Virginia. To help ensure the area is preserved, the organization monitored on 48 occasions at eight locations for temperature, dissolved oxygen, pH, nutrients, and *E. coli* bacteria. DEQ will assess the submitted data.

The **James City County Stormwater Division** collected *E. coli* samples using the Coliscan Easygel method. From April 2009 to March 2010, county staff collected 140 samples at 12 locations to identify areas of high *E. coli* populations. The results were submitted to DEQ to help with TMDL IP underway in the area to identify locations that could benefit from the installation of BMPs. DEQ included submitted data in this report to determine if follow-up monitoring is necessary.

The **National Park Service Assateague Island National Seashore** participates in a multistate monitoring program in waters surrounding Assateague Island on Virginia's Eastern Shore. Park staff collected 423 samples at 6 sites located in Virginia to test for nutrient levels, algae concentration, and field parameters. DEQ will use the nutrient and field parameter data to assess water quality conditions.

The **National Park Service Mid-Atlantic Monitoring Network** is a regional program linking the various National Parks in order to conduct environmental sampling using standardized methodologies. In Virginia, the Appomattox Courthouse National Historical Park, Booker T. Washington National Monument, Fredericksburg and Spotsylvania National Military Park, Petersburg National Battlefield Park, and Richmond National Battlefield Park have participated in this program. From June 2009 to December 2012, the parks monitored 38 stations composed of 730 sample events. The parks sampled for dissolved oxygen, pH, temperature, and conductivity. After reviewing the protocols, DEQ will assess water quality conditions for dissolved oxygen, pH, and temperature.

The **National Park Service Northeast Coastal & Barrier Network** monitored the Potomac, James and York Rivers for temperature, dissolved oxygen, conductivity, salinity, chlorophyll a, and water clarity. DEQ received 653 samples at 102 sites. After reviewing methodologies, DEQ will assess water quality using temperature and dissolved oxygen. Chlorophyll a and water clarity readings are not used in assessment due to the lack of numerical water quality standards in the sampled waterbodies.

The **Occoquan Watershed Monitoring Laboratory** monitors field parameters and total phosphorous at 8 sites along the Occoquan Reservoir. Trained field and laboratory staff conducted 5,314 sample events during the six year assessment window. Based on review of field and laboratory protocols, DEQ will include the results to assess water quality at the reservoir.

Page County Department of Environmental Services conducted an intensive *E. coli* monitoring program in the Hawksbill Run watershed using Coliscan Easygel. This project was supported through DEQ to determine potential bacteria sources and areas to establish restoration projects as part of the Hawksbill Run TMDL IP. Page County staff sampled at 21 stations in Hawksbill Run collecting 341 samples from January 2007 through February 2010. DEQ included submitted data in this report to determine if follow-up monitoring is needed.

The **Pocahontas State Park** staff monitored a site at Bear Creek State Park for dissolved oxygen, temperature, pH, and water clarity. DEQ assessed the submitted 62 sample events to determine if follow up sampling by DEQ is needed.

The **Tennessee Valley Authority** (TVA) conducts reservoir monitoring along the South Fork of the Holston River. The monitoring consisted of collecting 597 sample events for *E. coli*, temperature, dissolved oxygen, pH, and nutrients at three sites. DEQ will use the nutrient and *E. coli* results to assess water quality. Dissolved Oxygen, pH, and temperature will be used to determine the need for follow up sampling by DEQ due to questions on the frequency and procedures used to calibrate TVA field equipment.

The **United States Forest Service** (USFS) conducts an intensive benthic macroinvertebrate study in and around the national forests in Virginia. The USFS monitored at 139 stations and collected 1,488 benthic macroinvertebrate samples from April 2007 to May 2012. Upon review of sampling protocols, DEQ will use the benthic macroinvertebrate data for assessing water quality.

The **United States Geological Survey** (USGS) submitted water quality data for 127 stations located in the eastern and central portions of Virginia. USGS staff collected and submitted data from 1,526 sample events from January 2007 to December 2012. The stations monitored many ambient water quality parameters from dissolved oxygen and pH to dissolved metals. In addition, USGS conducted continuous monitoring of dissolved oxygen, pH, and temperature at 15 of the stations composed of 346,575 sample events during the six year window. The USGS follows standard protocols for sampling and analysis of results. USGS monitoring data identified as having a Virginia Water Quality Standard were used by DEQ to assess water quality.

The **Virginia Department of Health** (VDH) collects *E. coli* and fecal *Enterococcus* bacteria samples from public beaches located in the eastern half of Virginia from May to October each year. For this assessment report, VDH staff collected 5,652 bacteria samples from 56 public beaches and submitted the results to DEQ. Due to VDH using the same sampling methods and laboratory procedures used by DEQ, VDH results were used by DEQ to assess water quality.

The **Wolf Creek Water Reclamation Facility** submitted water quality data collected upstream of their facility to DEQ. From January 2008 through December 2012 the staff collected 56 samples from one sample site located upstream of their facility. Submitted data included stream flow, temperature, dissolved oxygen, pH, Biochemical Oxygen Demand, nutrients, and *E. coli* bacteria. DEQ will assess water quality for temperature, pH, nutrients, and *E. coli*.

Table 3.5-2 Non-Agency Data Submitted: Level II and Level III

Non-Agency Organizations	Potomac/ Shenandoah		James		Rappahannock		Roanoke		Chowan		Tennessee		Chesapeake Bay		York		New		Big Sandy		Unknown / VDPES		Total	
	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events	Sites	Events
Appalachian Electric Power							10	60															10	60
Appalachian Technical Services, Inc.											106	216							49	50			155	266
City of Norfolk Department of Utilities			18	7557																			18	7557
City of Suffolk			18	320																			18	320
Cumberland Resources Company																			2	46			2	46
DCR Beach Program	3	12	18	518			9	237			6	126			3	72	3	84					42	1049
Edge Valley Preservation LLC			8	48																			8	48
James City County Stormwater Division			12	140																			12	140
National Park Service Assateague Island National Seashore													6	423									6	423
National Park Service Mid-Atlantic Monitoring Network			15	351	5	154	10	201							1	11					7	13	38	730
National Park Service Northeast Coastal & Barrier Network	47	269	50	342											5	42							102	653
Occoquan Watershed Monitoring Laboratory	8	5314																					8	5314
Page County Department of Environmental Services	21	341																					21	341
Pocahontas State Park			1	62																			1	62
Tennessee Valley Authority											3	597											3	597
United States Forestry Service	20	43	74	141							14	21	13	1252			17	30	1	1			139	1488
United States Geological Survey	58	199077	21	209	5	57	28	134898			4	13729			4	47	6	70	1	14			127	348101

VDH Beach Program	1	130	9	947			9	974			20	1688	17	1913				56	5652					
Wolf Creek Water Reclamation Facility									1	56								1	56					
Total number of stations/samples	158	205186	244	10635	10	211	66	136370	0	0	134	14745	39	3363	30	2085	26	184	53	111	7	13	767	372903

Current Efforts to Support Citizen and Non-Agency Surface Water Quality Monitoring

DEQ is committed to expanding the use of non-agency surface water quality monitoring data in future assessment reports. This is primarily due to an increasing need for additional water quality data and the growth in the sophistication in water quality monitoring by sources outside of DEQ. During the past couple of years, DEQ has been working on several projects to increase the amount and quality of non-agency data available.

For over eight years, DEQ has provided equipment to citizen groups to monitor for *E. coli* bacteria using the Coliscan Easygel method. Candidate groups are selected based on their willingness to monitor in bacteria impaired waterbodies which currently have a TMDL Implementation Plan in place or soon will be. When funding is available, DEQ provides Coliscan kits to groups who can perform monthly monitoring at ten or more locations in the TMDL waterway. The volunteer groups share the results with DEQ, and other interested parties such as local governments, to help identify areas of high fecal bacteria loading such as due to broken sewer lines. This information helps to refine implementation activities. In addition, the volunteers often share their findings with their neighbors which have helped improve participation in non-point source best management practices.

In 2005, DEQ, in partnership with the Virginia Water Monitoring Council (VWMC), developed a web-enabled application for the public to find contact information on water quality monitoring organizations across Virginia. In 2013, this application was moved to a Google based platform and now shows the locations of monitoring sites found on the DEQ citizen/non-agency database at www.deq.virginia.gov/easi/. By using Google maps, it allows for faster updates and more capabilities than possible using the standard GIS mapping software. The VWMC application is accessible through the VWMC website <http://vwrrc.vt.edu/vwmc/data.asp> or by visiting the DEQ follow up monitoring website <http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring/FollowupMonitoring.aspx>.

Currently, DEQ is developing a series of training videos covering popular water quality monitoring methods such as Coliscan Easygel and dissolved oxygen sampling. The goal of these videos is to provide introductory or refresher training that volunteer groups can refer to. In addition, these videos will supplement material found in the popular *Virginia Citizen Volunteer Water Quality Monitoring Program Methods Manual* available on the DEQ citizen monitoring page at www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx

Through these new and continuing efforts, DEQ is able to utilize data that was previously unavailable or unknown to the agency. DEQ values the contributions of non-agency monitoring staff and citizen volunteers and will continue to support their monitoring efforts however possible. With assistance from these organizations, DEQ is increasing monitoring coverage in Virginia.

Additional information about DEQ's continued support of volunteer and non-agency monitoring is available at:

www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx

You May Also Contact:

James Beckley
Quality Assurance Coordinator
PO Box 1105
Richmond, Virginia 23219
(804) 698-4025
james.beckley@deq.virginia.gov

Stuart Torbeck
Water Quality Data Liaison
PO Box 1105
Richmond, Virginia 23219
(804) 698-4461
stuart.torbeck@deq.virginia.gov

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